

Growing the Space Weather Enterprise

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Progress in Partnership

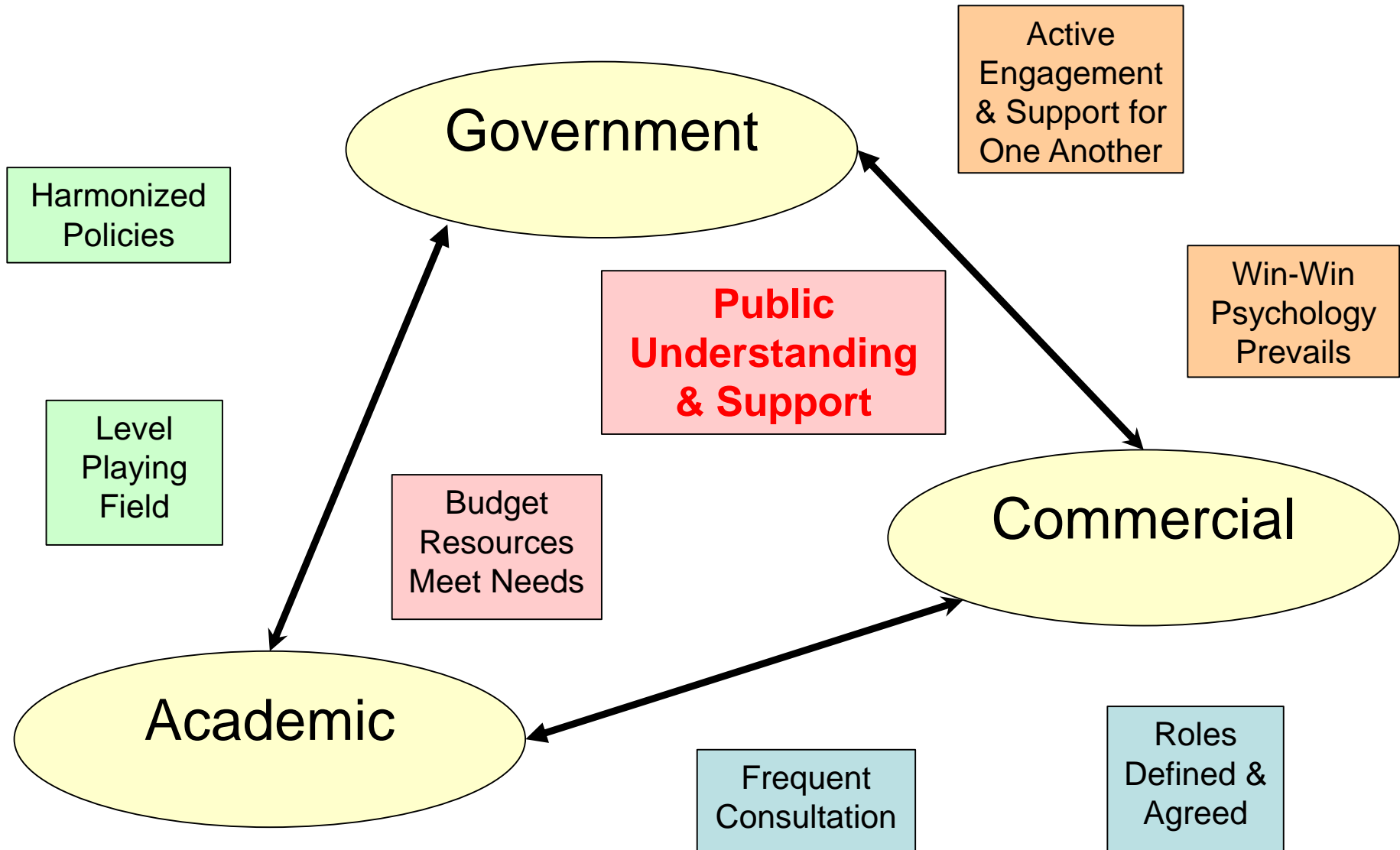
Space Weather Workshop
Boulder, CO
April 27, 2016

Conrad C Lautenbacher, Jr
CEO, GeoOptics, Inc

Agenda

- Space Weather “Enterprise”
- Recent Developments
 - Space Weather Operations, Research, and Mitigation (SWORM) Task Force
 - National Space Weather Strategy
 - Space Weather Action Plan (SWAP)
- Commercial Contribution Potential
 - ACSWA Status
 - Specific capabilities
- Summary

(Successful) Partnership



Partnership

White House Water Summit*

- **Presidential Memo and Action Plan**
 - National Drought Resilience Partnership
 - New National Water Model released
- **\$4B private capital committed to investment**
 - \$1.5B alone from Ultra Capital
 - Infrastructure projects
- **1\$B private sector committed to R&D**
 - \$500m Alone from GE
 - Specific capabilities
- **\$35M this year in Federal grants**
 - EPA, NOAA, NSF, Agriculture

*<https://www.whitehouse.gov/the-press-office/2016/03/22/fact-sheet-working-together-build-sustainable-water-future>

Partnership

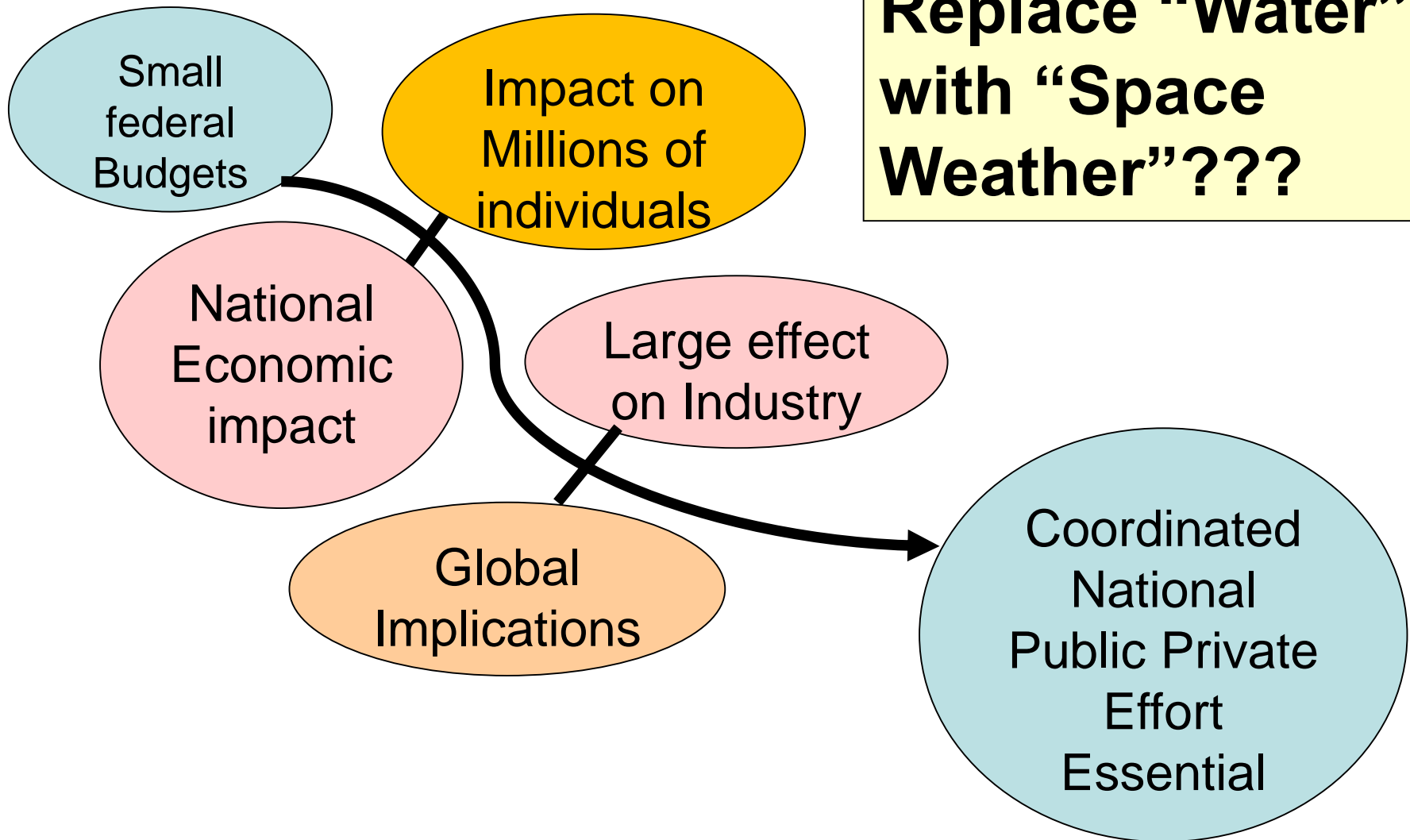
White House Water Summit*

- Water challenges face communities & regions
 - Impact millions of lives
 - Billions of dollar in damages
- Importance of solving now and for future
 - Cross-cutting creative solutions for today
 - Protecting for the future
- Call to action
 - 150 external institutions joining Federal government
 - New efforts and commitments
 - Accelerate development and demonstration
 - Deployment of innovative technologies and tools
 - Raise public awareness

*<https://www.whitehouse.gov/the-press-office/2016/03/22/fact-sheet-working-together-build-sustainable-water-future>

Partnership

**Replace “Water”
with “Space
Weather”???**



SWORM

Co-Chairs

Department of Commerce, NOAA
Department of Homeland Security
Office of Science and Technology Policy

Members

Departments

Commerce
Defense
Energy
Homeland Security
Interior
State
Transportation

Executive Office

National Security Council
Office of Management and Budget
Office of Science and Tech Policy
White House Military Office

Agencies and Service Branches

Federal Aviation Administration
Federal Communications Commission
Federal Emergency Management Agency
Federal Energy Regulatory Commission
National Aeronautics and Space Admin
National Oceanic & Atmospheric Admin
National Science Foundation
Nuclear Regulatory Commission
Office of the Director of Nat'l Intelligence
United States Air Force
United States Geological Survey
United States Navy
United States Postal Service

National Space Weather Strategy*

Introduction

“The Strategy and Action Plan build on recent efforts to **reduce risks** associated with natural hazards and reduce risks associated with natural hazards and **improve resilience** of essential facilities and systems, aiming to foster a **collaborative environment** in which **government, industry,** and the **American people** can better understand and prepare for the effects of space weather.”

“The Nation must continue to **leverage existing public and private network of expertise and capabilities** and pursue targeted enhancements to improve the ability to manage risks associated with space weather.”

*https://www.whitehouse.gov/sites/default/files/microsites/ostp/final_nationalspaceweatherstrategy_20151028.pdf

National Space Weather Strategy*

Strategic Goals

1. Establish Benchmarks for Space Weather Events
2. Enhance Response and Recovery Capabilities
3. Improve Protection and Mitigation Efforts Public Good & Government Control
4. Improve Assessment, Modeling, and Prediction of Impacts on Critical Infrastructure
5. Improve Space Weather Services through Advancing Understanding and Forecasting
6. Increase International Cooperation

*https://www.whitehouse.gov/sites/default/files/microsites/ostp/final_nationalspaceweatherstrategy_20151028.pdf

Commercial Contributions

1. Establish Benchmarks for Space Weather Events

- Benchmarks & metrics basis of partnership success
 - Automatic solar wind structure detections (CMEs, coronal holes)
 - Benchmark solar wind disturbance to main field
 - Automatic SPE detections
 - Benchmarks for ionizing radiation at aviation altitudes
 - Web-delivered and interactive plots (1986-present)
 - Expertise in aviation radiation measurements

Commercial Contributions

2. Enhance Response & Recovery Capabilities

- Base for developing simulations and “war-gaming”
- Knowledge and Experience to connect parties
- Public-Private Partnerships already formed
- Tailored numerical modeling and simulation
- Risk and threat analysis of infrastructure and space resources
- Space Situational Awareness (SSA)

Commercial Contributions

3. Improve Protection & Mitigation Efforts

- Provide models for forecasting, design, mitigation, risk reduction, vulnerability analysis
- Provide hardware for observations, threat detection, risk reduction
- Develop low cost solutions for meeting requirements
- Customer-oriented priority setting
- Concentration on ease of use and user friendly
- Range of services and scaled support

Commercial Contributions

4. Improve Assessment, Modeling, and Prediction of Impacts on Critical Infrastructure

- Tailored numerical modeling and simulation
- Operational implementations
- Research to Operations (R2O) expertise
- Risk and Threat analysis for infrastructure/space
- GPS modeling and services
- Modern networking technology
- New sensor technology

Commercial Contributions

5. Improve Space-Weather Services through Advancing Understanding and Forecasting

- Models based on automatic detections, machine learning and physics
- Web-delivered, interactive products
- Reaching a broader audience
- Spacecraft weather data product and service distribution
- Risk and threat analysis for space resources
- End-to-end expertise emphasizing R2O

Commercial Contributions

6. Increase International Cooperation

- Existing international partners
- International customers
- Agreements with international universities
- Access to real time international data
- COSPAR engagement
- Ongoing overview of international efforts toward operationalizing space weather

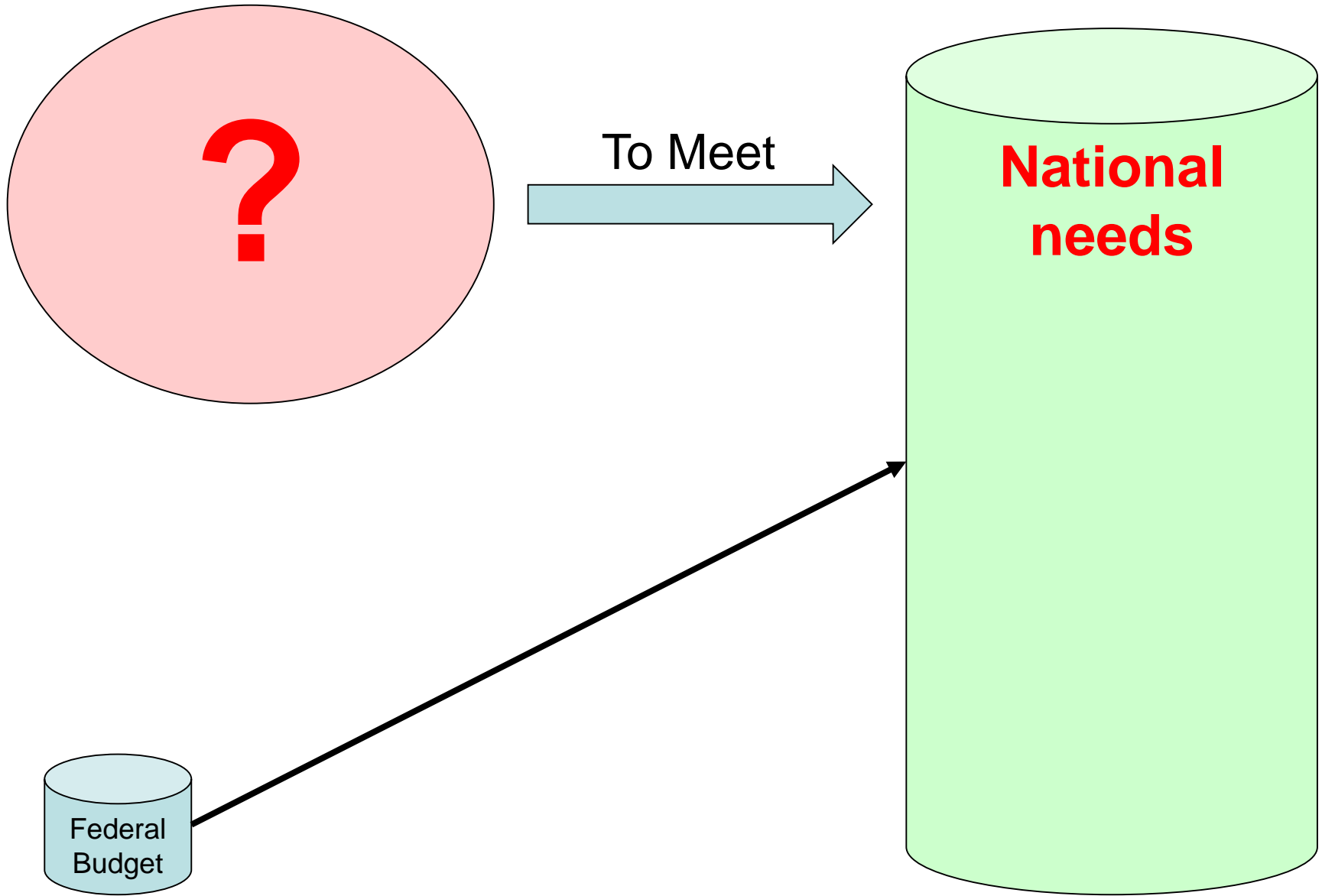
American Commercial Space Weather Association

Capabilities*

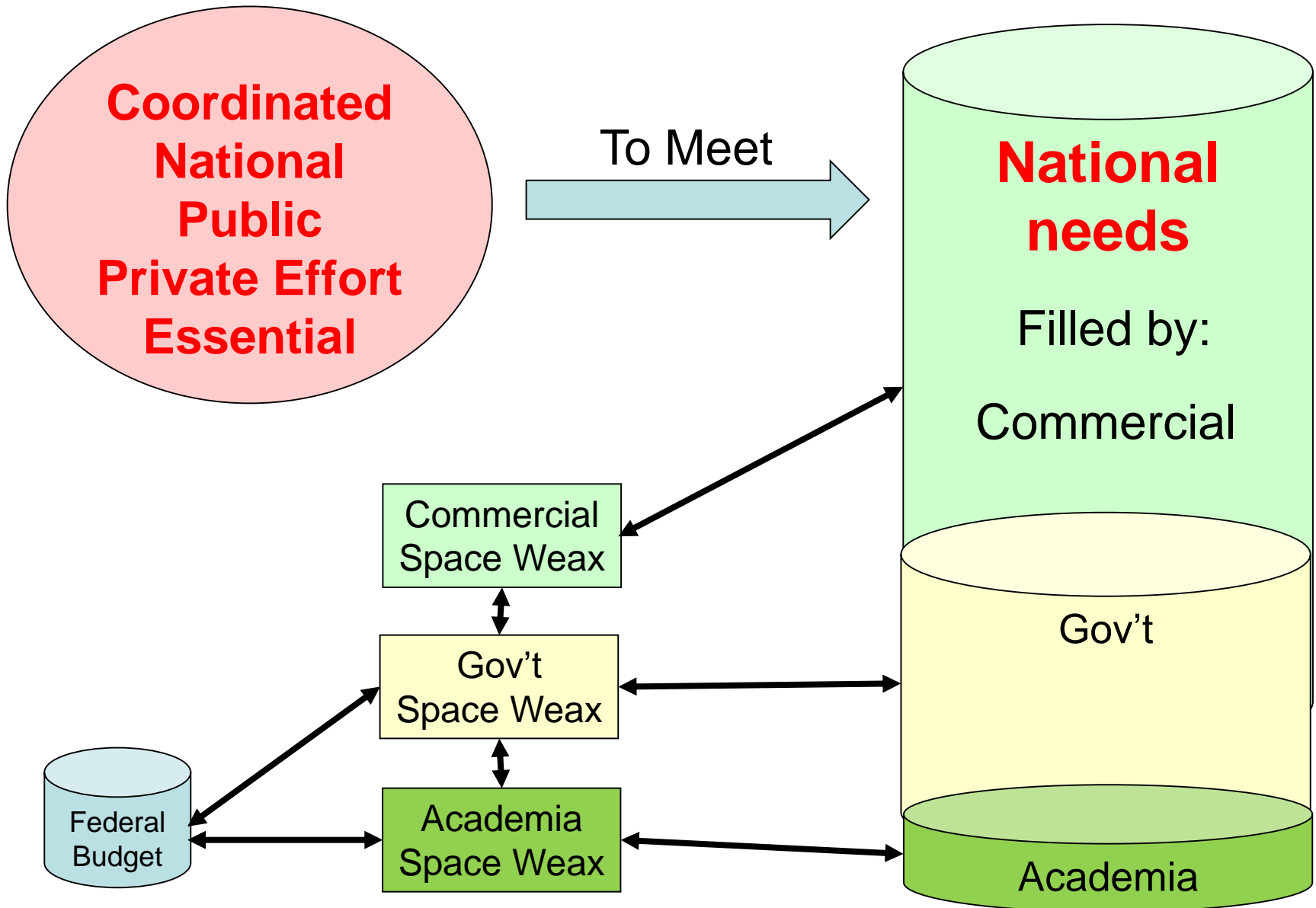
- Algorithm development
 - Automatic event detections (flares, solar energetic particles, geoeffective CMEs)
- Calibration/validation
- Data assimilation
- GPS modeling and services
- HF propagation
- Numerical modeling and simulation
 - Sun, interplanetary medium
 - magnetosphere, ionosphere
 - thermosphere, lower atmosphere
- Operational implementations / Research to Operations (R2O)
- Risk and threat analyses for infrastructure and space resources
- Satellite data analysis & data product development
- Sensor hardware & modeling
- Software tools
 - Application development (web-based and smart phone)
 - Data hosting / data product delivery
 - Data / model visualization
- Space Situational Awareness (SSA)
- Spacecraft anomaly prediction and assessment
- Space weather data product and service distribution
- Space weather now-casting/forecasting

*<http://www.acswa.us/capabilities.html>

Dilemma



Partnership



Summary

- Actions Completed
 - Government wide task force (SWORM) formed!
 - National Space Weather Strategy
 - Space Weather Action Plan (SWAP)
 - Planning in Place
- For the Future
 - Increased sector collaboration
 - Completion of ambitious SWAP deadlines
 - Obtain maximum use of limited resources
 - increased use of public-private partnerships
 - Smart leverage of commercial sector expertise
 - Modernization of observation assets



The Environmental Data Services Company

The End

Solar Cycle Process

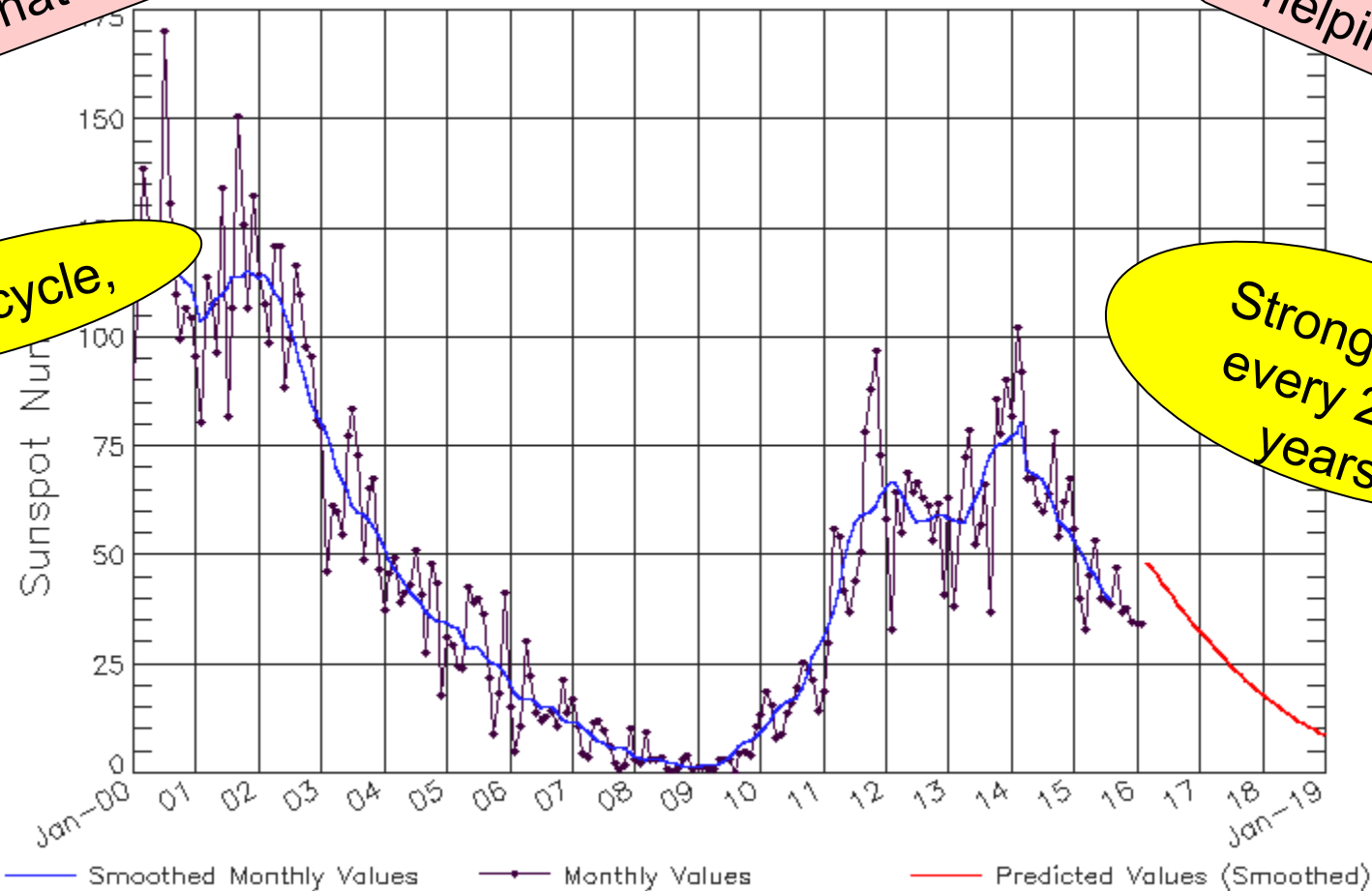
ISES Solar Cycle Sunspot Number Progression
Observed data through Feb 2016

Unfortunately,

The **sun** is not helping us!!

Ideal cycle,

Strong peak every 2 – 4 years!



Updated 2016 Mar 7

NOAA/SWPC Boulder, CO USA

St. Patrick's Day 2015 Geomagnetic Storm*

- **G4 level (severe) geomagnetic storm**
- Commencement: ~14:00 UT (10:00 EDT)
- **Duration: ~18 hours** (G3/G4 conditions sustained for 12 hours)
- Maximum magnetic field (Bz): -30 nT (-20 nT sustained)
- **Strongest G4 storm of Solar Cycle 24 (out of only 5)**
- No proton or electron radiation enhancement with this storm (unusual)
- Cause: Coronal mass ejection(s) at ~0200—0230 UT on 15-March
- Impacts:
 - 200 mV/km induced electric field calculated for NE powerplant locations (about 1/10 of the March 13, 1989 values). **No power failures reported to date.**
 - Severe ionospheric density depletion above 45° latitudes; strong scintillation at equatorial latitudes reported (e.g. Brazil).
 - Spectacular auroral sightings from Michigan to Alaska and as far south as southern Colorado (Montrose county) on early morning of 17-March.
- **Forecast accuracy:**
 - **CME was 15 hours ahead of forecast**
 - **Maximum geomagnetic storm predicted = G1 on 18-March-2015**

*Courtesy of Dr. Tom Berger, SWPC, NWS, NOAA

American Commercial Space Weather Association

- Formed in 2010, 5 Members;

- 2016, 19 Members:

AER, ASTRA, CPI, CRC, FF, GO, IS,
PiQ, PRA, PSI, Q-up, SAC, SEC,
SET, SSI, SSH, SA, SWFTT, WA•



www.acswa.us

Executive Committee:

G. Crowley (ASTRA)

A. Engle (WA)

D. Intriligator (CRC)

C. Lautenbacher (GO)

R. Robinson (IS)

R. Schunk (SEC)

K. Tobiska (SET)



U.S. Government Space Policy*

To promote a robust domestic commercial space industry, agencies shall:

- Purchase commercial space services to the maximum extent
- Modify commercial space services when cost effective & timely
- Explore nontraditional arrangements for acquiring commercial space services
- Develop USG space systems only when no US commercial service available
- Refrain from activities that compete with US commercial space activities
- Pursue opportunities for transferring routine space functions to the commercial space sector
- Cultivate entrepreneurship in the commercial space sector through incentives
- Ensure USG space technology available for commercial use

*http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf

NOAA Policy*

NRC study (Fair Weather: Effective Partnerships in Weather and Climate Services, National Research Council, 2003)

<http://www.noaa.gov/partnershippolicy/>

Formalized as NOAA Administrative Order 216-112 (July 2007)

Extracts

The three-sector Environmental Information Enterprise has led to an extensive and flourishing set of services that are of great benefit to the public and the economy.

NOAA has a responsibility to foster the growth of this complex and diverse enterprise as a whole to serve the public interest and the Nation's economy.

Nation benefits from government information disseminated both by federal agencies and by diverse nonfederal parties, including commercial and not-for-profit entities.

NOAA will not haphazardly institute significant changes in existing information dissemination activities, or introduce new services,.....

*NOAA's Policy on Partnership; Edward Johnson, Dir Strategic Planning & Policy NWS 1/22/ 2015

NOAA Policy*

NWS Implementation (Directive 1-10)

partnership policy clause 4:

(Language adopted in clarification highlighted)

The nation benefits from government information disseminated both by Federal agencies and by diverse nonfederal parties, including commercial and not-for-profit entities. NOAA recognizes cooperation, not competition, with private sector and academic and research entities best serves the public interest and best meets the varied needs of specific individuals, organizations, and economic entities. NOAA will take advantage of existing capabilities and services of commercial and academic sectors to support efficient performance of NOAA's mission and avoid duplication and competition in areas not related to the NOAA mission. NOAA will give due consideration to these abilities and consider the effects of its decisions on the activities of these entities, in accordance with its responsibilities as an agency of the U.S. Government, to serve the public interest and advance the nation's environmental information enterprise as a whole.

*NOAA's Policy on Partnership; Edward Johnson, Dir Strategic Planning & Policy NWS 1/22/ 2015

Fair Weather Report*

- Recognizes the Three Sectors
 - NWS (Government) -- protecting life and property and enhancing the national economy
 - Academia -- advancing science and educating future generations
 - Private Sector – production of products and services tailored to client needs
- System is productive but with built-in frictions
 - All contribute to same activities – Differentiating roles difficult
 - Different philosophies of sharing data and models
 - New technologies and user communities emerge affecting role definition
- Eleven Recommendations
 1. NWS defines processes for making decisions not products
 2. NWS Establish independent advisory body
 3. All three parties seek neutral host to discuss issues periodically
 4. NWS maintain activities essential to mission
 5. NWS Make data and products available in internet accessible formats
 6. NWS Improve process for developing new products that meet new needs
 7. NWS develop process to balance local new product creation with public-private partnership
 8. NWS Adopt/improve processes for communicating information in probabilistic formats
 9. NWS retain role as official source of instrumentation, data, and data collection standards
 10. Private sector work with other sectors to develop processes to minimize friction
 11. Academia use transparent processes to transfer technologies and avoid conflicts of interest

*Fair Weather: Effective Partnerships in Weather and Climate Services (2003) NRC Report